

WHAT IS CLAIMED IS:

1 1. An apparatus for feature processing of telecommunications signals, the
2 apparatus being adapted to operate in a CELP domain without decoding to a speech signal
3 domain, the apparatus comprising:

4 a dual-tone modulation frequency (DTMF) signal detection module, the dual-
5 tone modulation frequency (DTMF) signal detection module being adapted to determine one
6 or more DTMF tones based upon at least one or more input CELP parameters, and the DTMF
7 signal detection module being adapted to output the one or more DTMF signals if
8 determined;

9 a multi-input mixing module coupled to the DTMF signal detection module,
10 the multi-input mixing module being adapted to process CELP parameters from more than
11 one CELP-based codecs, representing respective more than one voice signals, into a single
12 set of CELP parameters.

1 2. The apparatus of claim 1 wherein the dual-tone modulation frequency
2 (DTMF) signal detection module comprises:

3 a DTMF feature computation unit capable of receiving the one or more CELP
4 parameters and external commands and computing one or more DTMF features,

5 one or more DTMF feature pattern tables having one or more specific feature
6 data corresponding to the one or more DTMF signals,

7 a DTMF feature comparison unit, the DTMF feature comparison unit being
8 adapted to process the one or more DTMF features derived from the DTMF feature
9 computation unit with the one or more specific feature data in DTMF feature pattern tables to
10 identify one or more DTMF specific signals and to classify the one or more DTMF specific
11 signals,

12 a DTMF feature buffer capable of storing the one or more DTMF feature
13 parameters and the one or more DTMF classification data of one or more previous sub-
14 frames or frames.

15 a DTMF decision unit capable of determining the one or more DTMF signals
16 from DTMF classification data of a current and one or more previous sub-frames or frames
17 according to one or more DTMF specifications and sending out the DTMF determined
18 signals.

1 3. The apparatus of claim 2, wherein the DTMF feature computation unit
2 processes the one or more DTMF features using at least one or more of linear prediction
3 parameters information, pitch information, energy information.

1 4. The apparatus of claim 2, wherein the DTMF feature pattern tables
2 having specific pre-computed feature data associated from CELP parameters corresponding
3 to the one or more DTMF signals.

1 5. The apparatus of claim 2, wherein the DTMF feature comparison unit
2 classifies DTMF specific signals corresponding to 16 digits of "1", "2", "3", "4", "5", "6",
3 "7", "8", "9", "0", "A", "B", "C", "D", "#", and "*" according to the internal
4 telecommunication unit (ITU) specification.

1 6. The apparatus of claim 2, wherein the DTMF decision unit further
2 comprises a logical state machine and DTMF signal criteria to determine the one or more
3 DTMF signals and one or more specific digits.

1 7. The apparatus of claim 1 wherein the multi-input mixing module
2 comprises:

3 a feature detection unit capable of receiving one or more sets of CELP
4 parameters and external commands and detecting a plurality of speech features;

5 a sorting unit capable of processing the detected features of the more than one
6 set of CELP parameters and ranking an order of importance for each set of CELP parameters
7 based upon a predetermined criteria;

8 a mixing decision unit capable of determining a processing strategy, selecting
9 some or all sets of CELP parameters for processing, and controlling the processing of the
10 more than one set of CELP parameters;

11 a mixing computation unit capable of processing more than one set of CELP
12 parameters.

1 8. The apparatus of claim 7, wherein the more than one set of CELP
2 parameters can be characterized by more than one voice compression standards, or two sets
3 of CELP parameters can be characterized by the same voice compression standard or all sets
4 of CELP parameters can be characterized by the same voice compression standard.

- 1 9. The apparatus of claim 7, wherein the more than one set of CELP
2 parameters may have been interpolated if they have been generated using different voice
3 compression standards to match the frame size, subframe size or other characteristic.
- 1 10. The apparatus of claim 1, further comprising a transcoding module
2 coupled to the DTMF detection module and being coupled to the multi-input mixing module.
- 1 11. The apparatus of claim 1, further comprising a transcoding module
2 coupled to the multi-input mixing module..
- 1 12. The apparatus of claim 1, wherein the multi-input mixing module and
2 the DTMF-signal detection module are provided in an advanced processing module, the
3 advanced processing module being coupled to a transcoding module..
- 1 13. The apparatus of claim 1, wherein the CELP parameters represent
2 silence descriptor frames.
- 1 14. The apparatus of claim 1 wherein the multi-input mixing module has a
2 dynamic topology and is capable of configuring different topologies according to the number
3 of input compressed signals.
- 1 15. The apparatus of claim 1 wherein the DTMF signal detection module
2 and the multi-input module are incorporated within a CELP-based voice transcoder.
- 1 16. The apparatus of claim 7, wherein the feature detection unit is adapted
2 to determine a plurality of speech signal features, the determining including classifying an
3 input represented by the CELP parameters as active speech, silence descriptor frames, or
4 discontinuous transmission frames.
- 1 17. The apparatus of claim 7, wherein the feature detection unit determines
2 a plurality of speech signal features including one or more of LSP spectrum information,
3 pitch information, fixed-codebook information, energy information.
- 1 18. The apparatus of claim 7, wherein the sorting unit receives data from
2 the feature detection unit, and arranges the order of importance of the multiple sets of CELP
3 parameters based upon the predetermined criteria.

1 19. The apparatus of claim 7, wherein the mixing decision unit receives
2 data from the sorting unit and external control commands to determine the sets of CELP
3 parameters that are processed.

1 20. The apparatus of claim 7, wherein the mixing computation unit can
2 pass through a single set of CELP parameters, or select and mix multiple sets of CELP
3 parameters, or send silence description data information.

1 21. A method for processing telecommunications signals in a CELP based
2 domain, the method including determining DTMF tones and processing multiple input
3 compressed signals using one or more CELP parameters of respective one or more CELP-
4 based coders, without decoding to a speech signal, the method comprising:

5 inputting the one or more sets of CELP parameters and external commands;

6 determining one or more DTMF tones in a compressed signal from the one or
7 more CELP parameters;

8 processing multiple sets of CELP parameters into a single set of CELP
9 parameters;

10 outputting the determined one or more DTMF tones, if detected, and the
11 processed CELP parameters in the single set.

1 22. The method of claim 21, wherein the CELP parameters includes one or
2 more of LSP information, pitch information, excitation vector information, energy
3 information, fixed-codebook information, and silence description information.

1 23. The method of claim 21, wherein determining DTMF tones comprises:
2 deriving DTMF feature parameters from CELP parameters;
3 processing feature parameters with pre-defined look-up tables of DTMF signal
4 feature data to output one or more results;

5 transferring the one or more results to the DTMF decision unit;

6 determining classification results of one or more previous subframes to output
7 one or more DTMF signals according to DTMF signal definition standards;

8 storing the one or more results of the current subframe and updating results of
9 one or more previous subframes; and

10 outputting DTMF tones, if a DTMF signal is detected.

1 24. The method of claim **21**, wherein the determining of the one or more
2 DTMF tones is performed for every subframe.

1 25. The method of claim **23**, wherein the deriving the one or more DTMF
2 features uses one or more of LSP spectrum information, pitch information, and energy
3 information.

1 26. The method of claim **23**, wherein the pre-defined look-up tables of
2 DTMF signal feature data are pre-computed by converting DTMF signals to CELP
3 parameters in a selected CELP compression format and are pre-loaded in tables before
4 DTMF detection processing.

1 27. The method of claim **21**, wherein the processing of multiple sets of
2 CELP parameters is capable of mixing the CELP parameters of more than two input codecs.

1 28. The method of claim **21**, wherein the processing of multiple sets of
2 CELP parameters can handle silence description frames and discontinuous transmission.

1 29. The method of claim **21**, wherein the processing of multiple sets of
2 CELP parameters comprises:

3 performing signal feature computation on each set of input CELP parameters;
4 arranging the order of importance of each set of input CELP parameters
5 according to the results of the signal feature computation;

6 determining the mixing strategy according to the order of importance and
7 external commands;

8 mixing the input sets of CELP parameters according to the chosen mixing
9 strategy;

10 outputting the mixed CELP parameters.

1 30. The method of claim **29**, wherein performing signal feature
2 computation computes signal features using one or more of LSP information, pitch
3 information, excitation information, fixed codebook information, energy information, silence
4 frame information.

1 31. The method of claim **29**, wherein the mixing strategies include
2 selecting only one set of CELP parameters with the highest importance, selecting a specific

3 set of CELP parameters according to an external command, mixing some of the input sets of
4 CELP parameters, or mixing all of the input sets of CELP parameters.

1 32. The method of claim 29, wherein the input sets of CELP parameters
2 are input channels to a conference call, and the sets of CELP parameters selected for mixing
3 do not include the CELP parameters of the destination channel, to avoid echo due to delay.

1 33. An apparatus for feature processing of telecommunications signals, the
2 apparatus being adapted to operate in a CELP domain without decoding to a speech signal
3 domain, the apparatus comprising:

4 a dual-tone modulation frequency (DTMF) signal detection module, the dual-
5 tone modulation frequency (DTMF) signal detection module being adapted to determine one
6 or more DTMF tones based upon at least one or more input CELP parameters, and the DTMF
7 signal detection module being adapted to output the one or more DTMF signals if
8 determined.

1 34. An apparatus for feature processing of telecommunications signals, the
2 apparatus being adapted to operate in a CELP domain without decoding to a speech signal
3 domain, the apparatus comprising:

4 a multi-input mixing module coupled to the DTMF signal detection module,
5 the multi-input mixing module being adapted to process CELP parameters from more than
6 one CELP-based codecs, representing respective more than one voice signals, into a single
7 set of CELP parameters.